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A STUDY ON ISSUES FACING THE STEEL RE ROLLING MILLS

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ABSTRACT

Steel Re Rolling Mills (SRRMs) have an important role the field of constructions. Steel tores used as a Reinforce meant material, These tores are produced either from its ores or from the scraps. At present Thermo Mechanically Treated (TMT) bars are produced from the companies. During the production, different process and operations are undergone. Since all the process is done at very high temperature, there is a chance of hazardous situations .Many issues are there in the SRRMs during the production process. In the field of marketing various factors are analysed. Demand may be based on the quality of the product and other properties. The quality is checked as per IS: 1786-1985. The quality assurance, price, availability etc. determines the demand of the product in the market. This paper peeps into the major issues facing by the SRRMs.

KEYWORDS: Steel Re Rolling Mills (SRRMs), Thermo Mechanically Treated (TMT), Properties of TMT, Issues of SRRMs, Energy Conservation

INTRODUCTION

Steel is crucial to the development of any modern economy and is considered to be the backbone of human civilization Steel rolling sector is self-sufficient in producing various common as well as most typical steel sections in their mills. Tor steel, flats, squares, special window sections, thin sized strips, and thin gaze strips, hexagons, wire rods, angles, channels, H-Beams, I-Beams, tele-channels etc are some of the products of Steel Re Rolling Mills(SRRMs) sector. The share of secondary steel production is expected to grow in the near future, because the sector has some competitive edge due to flexibility in production for meeting low tonnage requirements in various grades, shapes and sizes to serve niche markets. The estimated domestic demand of the re-rolled products has been estimated at about eight million tonnes. The industry has catered thousand and thousand tonnes of its products to core projects, dams, State Electricity Boards and other infrastructure projects in the country. The steel re-rolling industry caters to the needs of the domestic sector up to the tune of 68 per cent of the total requirement. 80 percent of the total exports of rounds and bars have been recorded from the secondary steel producers. Steel production is an energy intensive process and there are more than 2000 small and medium sized (SME) steel re-rolling mills in India, wherein 75 per cent of units are small scale. In a state of India, Kerala about 95 percent of the steel producing units are in small scale sector. The SME steel rerolling mill sector constitutes an unavoidable link in the overall supply chain of steel in the country. The direct energy use in this sector includes heating fuels (furnace oil, natural gas and coal), and electrical energy. The direct energy cost in the SME mills is estimated at 25-30 percent of overall production cost the process involved in the Steel Re-rolling Mills industry is such that if appropriate measures are not taken, it may lead to pollute water/air. Therefore, it is mandatory that Steel Re-rolling Mills industry must be established only after seeking proper consent to establish under Air (Prevention & Control of Pollution) Act, 1981 (Air Act) and Water (Prevention & Control of Pollution) Act, 1974(Water Act). Likewise, after establishing, the SRRMs industry must be brought to operation only after valid consent to operate under the above mentioned laws. Any

violation in this regard is a criminal offence. (MID-TERM REVIEW, Energy Efficiency in Steel Re-Rolling Mills, Government of India, United Nations Development Programme, Global Environment Facility, 2012)

PRODUCTION STATUS IN SRRMs

Different ranges of steel tores are making in a steel re rolling mill, usually from 6mm onwards. The main purpose of these tores is for the concrete reinforcement. In India there are more than 1500 SRRMs are working. Different techniques are used to fabricate these re-bars. High quality bars are produces from the ore itself. But large scale production is from scraps only. Around 95% of the steel tores are produced from scraps only. In order to get quality bares thermex or tempcore technologies are used (J. Adamczyk, A. Grajcar, 2006). Thermex process is explained below.

In **"Thermex Process",** from the finishing stand of the rolling Mill, the re-bars are guided through a specially designed proprietary Thermex pipes in which water quenching is done under controlled conditions. (Jacob P. George, Pramod V.R, 2013, C. A Klinkenberg,2004) The surface temperature of the hot re-bars falls drastically from 900ºC to around 400ºC on account of the intense and uniform cooling; whereas the core temperature remains the same. At the cooling bed, temperature equalizing takes place at round 600ºC. This makes the surface of the re-bar a hardened structure called martensite and the core remains soft and is known as ferrite-pearlite. Tensile strength, ductility and weldablity of the bar are increased by this kind of process. It is a patented technology from Health and Safety Executive (HSE), Germany under the brand name of **"**Thermex**"**. *Structural Steel* of medium section is rolled at the units.

In Thermo Mechanically Treated (TMT) process, hot bars are subjected to quenching by means of an intense cooling installation (cooling installation specially designed spray system). This step hardens the surface layer to martensite while the core structure remains austensite. When the bar is out of water chamber, heat flow will be from core to the outer surface and thus surface gets tempered to a structure called martensite, Due to atmosphere cooling, In the cooling bed the hardened zone is tempered by temperature homogenization in the cross section and the austensite core is converted into ductile-ferrite-pearlite core. (T. Gladman, 1997)

TMT is an acronym for the phrase 'thermo-mechanical treatment'. The Bureau of Indian Standards (BIS) while issuing the new code IS: 1786-1985 was the first to use this phrase while making reference to the 'Technological advances during the last few years in the field of deformed bar production. Micro alloying and thermo mechanical treatment process are worth mentioning in this field' .The technological advances referred to in the IS code are the quenching processes 'Tempcore' and 'Thermex' which received world patents and quick global acceptance amongst engineers. It must be stressed for the benefit of all (and the civil engineers in particular) that neither of these two patented processes employs any mechanical treatment whatsoever. Instead they obtain the unique properties in the rebars by "quenching and tempering" as mentioned earlier. After the process of rolling, the deformed steel bar is passed through a sudden cooling or quenching line. Thus the periphery of baris subjected to an intense water quenching in a short time while the core remains largely unaffected. On leaving the quenching chamber the core heat is utilised to temper the quenched outer surface. The resulting structure is a concentric tempered martensite periphery with a softer ferrite-pearlite core. (A. Kumar, et al, 1995), (K Priyesh, 2013).

PROPERTIES OF TMT BARS

The various grades of TMT bars are Fe 415, Fe 415D, Fe 500, and Fe 500 D, where the number indicates its yield stress in N/mm*2, as per IS 1786:2008 .

The major advantages of TMT bars are given below

- Enhanced bond strength,
- Better elongation properties,
- Better metallurgical properties,
- Superior weld-ability,
- Highly corrosion-resistant,
- Seismic – resistant,
- Perfect roundness,
- Precise gauge control.

For the TMT process, bars do not need cold twisting and hence these bars show excellent resistance to corrosion. Their Chemical compositions are Carbon-0.3%, Sulphur-0.05%, Manganese-0.5-1.2%, Phosphorus-0.05%. Mechanical properties are tensile strength-630n/mm, yield strength-520n/mm, elongation-22%., such bars are are used as reinforcement in the concrete. Concrete shows good compressive strength but poor tensile strength which demands for reinforcement. Desired properties of reinforcement are:

- High strength,
- High tensile strain ,
- Good bond to the concrete4.thermal compatibility,
- Durability in the concrete environment.

TMT process after coming out of the last rolling mill bars are water cooled in a microcontroller controlled quenching chamber where temperature gradient is produced in from core to surface. After the intensive cooling, the bar is exposed to air and the core re-heats the quenched surface layer by conduction, therefore tempering the external martensite. When the bars are taken out of the cooling system, the heat flows from the core to the outer surface, further tempering of the bars, which helps them attain higher yield strength. Properties due to such unique composition TMT bars show excellent tensile strength bend ability, ductility. Good corrosion resistance and excellent bonding strength with concrete. (www.concretebasics.org)

MAJOR ISSUES OF SRRMs

Since the production need high and controlled heat, need of Thyrister controlled power supply is very urgent. The melting temperature of mild steel is 1600*0 C. In order to save energy, a control of temperature is urgent. This control comes in induction furnaces. The molten metal is again chemically analysed. To get the required chemical composition chemicals are added along with it. It is again poured in to the mould and cooled to get the billet or ingot. The hot solid billets are again feed to another heating chamber were it is heated bellow the melting temperature. Since the billets are hot and it is to be displaced, suitable material handlings are essential. The path of the transportation is to be cleared that means hazardous situations are to be avoided.

Then the billets are again directed for rolling and re rolling process. The diameter of the bar is to be controlled and the elongation is also to be controlled by the applied force while the rolled bar is drawing. The elongating bar is then fed through the TMT bed and further cooled. Then it is cut at the correct length and cooled naturally and it is stacked for the

distribution. Through trucks or containers or stocked in go downs. Samples are taken before and after each process and undergoing physical and chemical tests.

The major issues facing the SSRMs are given below

- Governmental red tapisms,
- Location site issues,
- Environmental issues
- Waste disposal and its control problems,
- Local body problems,
- Transportation issues,
- Power resources issues,
- Managerial and managing issues,
- Availability of labour and raw materials issues,
- Market competition,
- Lab facility problem,
- Taxation and other issues,
- Ancillary units,
- Hazardous occurrence issues,
- Labour issues
- Other related issues and problems.

The industrialist in this field says that in order to start one company there are many lacuna to face even at the initial stage. Though the government encourages and enhances many opportunity, when it comes in to realities there are enough blockade and red tapisms. They demand many formalities and submission of complicated forms. Along with this, the resistance from the localities for the sake of political pressure and interference is another crisis. Land acquisition is another issue in this regard. Local panchayath/village office has to give permission to commence the start of infra structure. They have to investigate and report to the local authority to give permission for the commencement. Usually the SRRM plants produce air pollutions to the nearby sites and some other chronic disease. Thus these types of companies are directed to start on special location such as industrial belt or industrial sectors.

Since heat energy is the main source needed for SRRMs, its availability and cost may be problem. Since the plants work in round the clock for all the day's at high voltage, high power electric energy is essential. Though electric induction furnaces are working, oil furnace may also use for reheating the casted billets. Electric power and furnace oil must be available at cheap rate. Different types of taxes may be another burden for the new venture of entrepreneurs. Need of raw materials, ancillary units are another burden for the new comer in this field. Availability and cheap labour is also essential for the units. In order to get good demand for the products the quality of TMT bars must be good. To keep up the quality a good lab facility is urgent. Facility for the sales they need very good markets. To reduce the accidents due to hazardous

situations, proper awareness and training must be given for the workers. The maintenance of machines and equipment is also important. Maintanance Quality Function Deployment (MQFD) may be implemented in the industry to avoid machine failure and to get long life for the machines. (Jacob P. George, Pramod V R, 2013)

"Each one has a position and every one in his position" This is important for the best management of the company. Proper inventory control for the raw inventory, semi finished and finished inventories are essential for the SRRMs. Proper order for raw material and punctual supply of TMT bars to the customer is also needed for keeping good relationship with the whole sale and retail customers.

CATEGORISATION OF STEEL RE-ROLLING MILL INDUSTRIES

In India each state has a State Board which has categorized the industries under Red, Orange and other categories depending on their pollution potential. Accordingly, the Steel Re-rolling Mills industries have been categorized as under red, orange or green such as:

Red-Induction/arc furnaces/ cupola or other furnaces, Waste lead acid batteries, other ferrous/nonferrous metals containing waste, waste/spent oil reprocessing/ recycling and other unit requiring registration/ approval under MH and TM ((Management, Handing and Trans boundary Movement) Rules, 2008. Rules,2008 is for processing/co-processing hazardous waste .Industry or processes involving metal treatment or process such as pickling, paint stripping, heat treatment, phosphating or finishing, and so on(Yamashina, H. , 2000).

Orange category is Ferrous and non- ferrous metal (without metallurgical operations), Green All those industries/project processes/ activities/mines which are not covered under Red or Orange category and are discharging waste water and/ or air emissions will be covered under Green category As per delegation of powers to regional Officers issued, for all the Steel Re-rolling Mills industries categorized under Orange and Green categories and for small and tiny scale wool scouring units covered under the Red category, the Regional Officers of the State Board will be the competent authority for grant or refuse of the Consent to Establish/ Operate under the provisions of the Water (Prevention and Control of Pollution)Act, 1974 and Air (Prevention and Control of Pollution) Act, 1981 located within their territorial Jurisdiction. For all the Red category of Steel Re-rolling Mills industries except for small and tiny scale wool scouring units, Head Office will be the competent authority for grant or refuse of the Consent to Establish/ Operate under the provisions of the Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981 and for grant/refuse of authorizations under the provisions of Hazardous Waste (MH and TM Rules, 2008, Report of state pollution control board)

In order to get the sanction from the competent authority a lot of formalities and procedures are there. Even all the requirements are correct the officials are reluctant to give sanctions. They are suppose to check all the possible loop holes in it and any kind of negligence may cause serious after effects in the society. Thus they have to be vigilant in giving sanction for the SRRM unit in a locality. We may say that this kind of delay as red tapisom.

SRRMs can only be established on a land owned by the promoter in a notified industrial sector/area or land having its land use for industrial purposes with restrictions of certain activities in specified area as notified by the central and state governments. Land location is important because the area must not be a thickly populated one. Air pollution and other hazardous effects on mankind is the problem Ear marked areas were environmental protection is needed may not be given for the purpose. The major environmental issues are the pollution created by Raw material handling, Induction furnace, slag handling, reheating furnaces, Rolling mills, fly ash handling, mill wastes, utilities etc. The national government has passed act for environmental protection, noise pollution regulations, Hazardous Material (Management,

handling and Transboundary Movement) rules notification, general Standards for Discharge of Effluents notifications etc. All the above rules and regulations are for the healthy environment for the human health.

The main sources of air pollution in SRRMs industry are furnaces and Diesel Generator (D.G) sets on which adequate air pollution control measures, stack heights and infrastructure facilities for air pollution monitoring are required to be provided. On small coal fired furnace, unit is required to install cyclone, multi cyclone, bag filter, wet scrubber or electro static precipitator (ESP) depending on the heating capacity. On all furnaces using liquid fuel or coal, height of the stack will be governed by flow rate of sulphur di-oxide emissions. However, in no case the stack height will be less than 11 meters. The type of air pollution control equipment required to be installed, emission standards to be complied and procedure for calculating the stack height is governed as per Environmental Pollution Acts (EPA) Notification no. GSR176 (E) dated 2.04.1996.Air emissions from D.G sets are presently governed by adequate stack height to be provided on the D.G. sets depending on its capacity. Emission Regulation published has given the formula for working out the stack height. For regulation of stack emissions of D.G sets of capacity more than 0.80 MW, separate standards are laid down vide GSR 489 (E) dated 9.07.2002 which needs to be complied with (www.undpgefsteel.gov.in).

GUIDELINES FOR OPERATIONS IN SRRMs

Following guidelines are given for handing, storage, treatment and disposal of the hazardous waste generated from the Steel Re-rolling Mills:

- The hazardous waste needs to be stored under covered shed so that problems like odour, surface water contamination, ground water contamination etc. do not occur.
- Transfer of hazardous waste for sale, recycling, reprocessing or disposal shall be done through the manifest system through manifest in prescribed form 3 only as per rule 21 of HWMR, 2008.
- Annual Report for each financial year to the State Board in Form of all the units generates the hazardous waste shall submit.
- The industry needs to obtain approval from the competent authority, in case the industry wants to utilize the hazardous waste as a supplementary resource or for energy recovery, or after processing.
- No hazardous waste can be stored beyond a period of 90 days except with the prior permission of the State Board as per rule 7 of the HWMR, 2008.
- All the Steel Re-rolling Mills having metal finishing operations called pickling, metal finishing, D.G. Sets etc., generating hazardous waste.

Inside of the SRRM, active hauls roads should be adequately wetted with water to avoid fly of waste to the sky. Exhausts of trucks for transportations of rock materials within the site should be directed upward. The storage and handling of the dust collected by the dust collection system must be carried out without fugitive particulate emissions. In Operation and maintenance**, t**he dust extraction and collection system must be regularly inspected maintained and monitored in good condition and shall be used as required. A high standard of housekeeping should be maintained properly. Ay piles of materials accumulated on or around the relevant plant shall be cleaned up regularly. Malfunctioning or breakdown of equipment leading to abnormal emissions should be dealt with promptly. In case of the abnormal emission due to equipment failure the process must be stopped (www.undpgefsteel.gov.in).

ENERGY CONSERVATION IN SRRMs

Energy conservation methods and techniques must be included in the SRRMs such as:

- Crop Length Optimization
- Rollers Guide
- Spindle and Coupling
- Anti Friction Roller Bearing
- Installation of Y-Roller Table
- Installation of Drop Tilters
- Installation of Tilting Table
- Quenching and Self-Tempering (QST) of Re-bars
- Oval Repeater
- No-Twist Block
- Silt Rolling
- Computerized Roll Pass Design
- Lubrication Technology
- Cast in Carbide Rolls in Conventional Stands
- Pre-Stressed Housing less Stands
- Endless Welding Roll
- Reactive Power Compensation
- Energy Efficient Drives for Rolling Mills
- High Voltage (HT) AC Motor for Rolling Mills
- Electronically controlled automatic devices.

Energy consumption is the major expense in SRRM industry. Energy for the induction furnace, oil furnace, re rolling and transportation need high cost. Thus conservation of energy is very much essential in this industry. The twenty points give an idea where we need more concentration in energy consumption. By taking more care of the above mentioned things, the total cost of the plant can be reduced. At present there are more than 1500 SRRMs are working round the clock in India. Due to the globalisation of market, availability of raw materials is not a problem. Cut throat competitions in the market in sales are another problem. Transportation cost, labour cost, power cost is increasing day by day due to the hike inflation rates. Liberalisation, globalisation and privatisation (LPG), marketing is found to be watched carefully. Regular managing in all the fields, such as operations and working of unit, wastage of materials, power consumption, accident prone chance, quality of the product, ability in marketing and profit making are more important.

It is the duty of management to see that as far as employee is concerned, "Everyone has a place and each one his positions". Then only the there must be some cordial relationship between the employer and employee in the industry. For the smooth function of the industry co operation among the employees are also essential. They must co ordinate the work together. Proper maintenance of all the units is to be checked regularly. For the long and efficient working this is good. Break down of any unit may create problems. Hence the ancillary unit's vicinity is also important so that proper replacement is easy. Availability of experts is needed nearby. Hence proper replacement or maintenance may be done without much delay (Owens GW, Knowles PR, 1992).

INDIAN SCENARIO

After independence, successive governments placed great emphasis on the development of an Indian steel industry. In Financial Year 1991, the six major plants, of which five were in the public sector, produced 10 million tons. The rest of India steel production, 4.7 million tons, came from 180 small 29 plants, almost all of which were in the private sector. India's Steel production more than doubled during the 1980s but still did not meet the demand in the mid-1990s, the government was seeking private-sector investment in new steel plants. Production was projected to increase substantially as the result of plans to set up a 1 million ton steel plant and three pig-iron plants totalling 600,000 tons capacity in West Bengal, with Chinese technical assistance and financial investment. The commissioning of Tata Iron & Steel Company's production unit at Jamshedpur, Bihar in 1911-12 heralded the beginning of modern steel industry in India. At the time of Independence in 1947 India's steel production was only 1.25 Mt of crude steel. Following independence and the commencement of five year plans, the Government of India decided to set up four integrated steel plants at Rourkela, Durgapur, Bhilai and Bokaro. The Bokaro plant was commissioned in 1972. The most recent addition is a 3 Mt integrated steel plant with modern technology at Visakhapatnam. Steel Authority of India (SAIL) accounts for over 40% of India's crude steel production. SAIL comprises of nine plants, including five integrated and four special steel plants. Of these one was nationalized and two were acquired; several were set up in collaboration with foreign companies. SAIL also owns mines and subsidiary companies (www.business-standard .com, www.annualreportservice.com)

Regarding the issues facing SRRMs in India, we see different situations. Since domestic raw material sources are insufficient to supply the Indian steel industry, a considerable amount of raw materials has to be imported. For example, iron ore deposits are finite and there are problems in mining sufficient amounts of it. India's hard coal deposits are of low quality. For this reason hard coal imports have increased in the last five years by a total of 40% to nearly 30 million tons. Insufficient freight capacity and a transport infrastructure that has long been inadequate are becoming increasingly serious impediments to economic development. Although the country has one of the world's biggest transport networks – the rail network is twice as extensive as China's – its poor quality hinders the efficient supply of goods. In the coming years a total of USD 150 billion is to be invested in transport infrastructure, which offers huge potential for the steel industry. In the medium to long term this capital expenditure will lay the foundations for seamless freight transport (www.economictimes.com, 2011**)**

Power shortages hamper production at many locations. Since 2001 the Indian government has been endeavouring to ensure that power is available nationwide by 2012. The deficiencies have prompted many firms with heavier energy demands to opt for producing electricity with their own industrial generators.

CONCLUSIONS

Steel consumption is rising very fast as a consequence of the prospective dynamic economic growth. Secondly, there is demand for high-quality products which India will not be able to supply in sufficient quantities for the foreseeable

future. These include products with surface finishing that helps them to be more durable and retain their value for longer. In general, the trend towards weight-optimized components persists; this improves the prospects for Western European exporters in the Indian market. (Yamashina, H. (2000). Since India is among the fastest developing country in the world, major constructions like bridges, dams, airports, residential buildings etc are going at a booming fashion. In a developing economy where infrastructure is getting boom, strength‟ of structural members is of great importance. The mentioned facts on the issues are relevant at the present scenario. The Government and SRRMs are to be taken care and necessary steps also must be taken to reduce the issues in such industries.

REFERENCES

1. J. Adamczyk, A. Grajcar, Effect of heat treatment conditions on the structure and mechanical properties of DP-type steel, Journal of Achievements in Materials and Manufacturing Engineering 17 (2006) 305-308.]
2. C.K kankam, M. Adom-Asamoah/ Materials and Design 23(2002) 537-545
3. DGS 527Specification for hot rolled steel bars for concrete reinforcement
4. T. Gladman, The Physical Metallurgy of Microalloyed Steels, The Institute of Materials, London, 1997.
5. Jacob P. George & Pramod VR, Mapping of steel re rolling mills, a practitioner's perspective, page 45-50,VolXXIX Journal of organisationalanagement(AIMA),2013)
6. K Priyesh, International Journal of Engineering Research & Technology (IJERT),Vol. 2 Issue 8, August - 2013
7. Owens GW, Knowles PR. Steel designer's manual. Blackwell Scientific Publications, 1992
8. Pee kay steels and castings pvt limited. Your guide to civil engineering basics TMT bars.mht
9. MH and TM Rules, 2008, Report of state pollution control board
10. MID-TERM REVIEW, Energy Efficiency in Steel Re-Rolling Mills, Government of India, United Nations Development Programme, Global Environment Facility-2012
11. www.economictimes.com, 2011**)**.
12. www.business-standard .com,
13. www.annualreportservice.com
14. www.undpgefsteel.gov.in
15. Yamashina, H., 2000) 'Challenge to world-class manufacturing', International Journal of Quality and Reliability Management, Vol. 17, No. 2, pp.132–143.

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